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Hydrologic Engineering Center

Fourth Quarter Activity Report

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Department of the Army
Corps of Engineers, Water Resources Support Center
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616-4687

(530) 756-1104

Activity Report

Hydrologic Engineering Center **Fourth Quarter 1999**

Executive Summary

The Water Control Data System, renamed Corps Water Management System (CWMS) software modernization and integration project is completing the third year of an intensive six year development and deployment effort. CWMS is the Corps decision support Automated Information Systems (AIS) that serves the Corps water management mission. Activity this past quarter focused on supporting the Test 1.0 installation. This is the first of two planned interim test installations prior to Test 3.0/CWMS Version 1.0, which will complete the system that will be deployed Corps-wide in 2001/2002. This past quarter, installations were completed at the four test sites: Baltimore, Huntington, Omaha District and the Northwest Region - Portland. HEC teams installed the software and trained users in decision support modeling and system use. A meeting of the senior management level Advisory Group is planned for July. Material about the project is posted on the Web at http://cw71.cw-wc.usace.army.mil/cwcinfo/cwc.html.

The NexGen software research and development project continues to roll along. The companion HEC-RAS Arc/Info GIS applications package (HEC-GeoRAS) that will provide cross section geometry from digital terrain models, and enable automated inundation mapping was released. It is being applied in a major project that will provide the basis for an illustrated applications guide. An ArcView version of HEC-GeoRAS is now being readied for release. The next major release of HEC-RAS, early in the next FY, will likely include both these companion GIS applications packages. A similar GIS companion to HEC-HMS, coined GeoHMS was recently extensively tested on a project and has a planned release of next Fiscal Year. Good progress continues for the planned summer release of Version 2.0 of HEC-HMS. This release will include a continuous moisture accounting loss algorithm, as well as other additions. Progress continues on the two NexGen software programs that are components of the CWMS. The real-time reservoir operations model (HEC-RSS), and a flood impact analysis model (HEC-FIA) are both components of the Test 1.0 CWMS software installation discussed above. The HEC-FIA program is being applied in the Sacramento-San Joaquin Comprehensive Study. These programs will continue to be improved and will eventually be released in stand-alone form. The HEC-FIA is further along and will be released in FY 2000.

The re-study of flood frequency on the upper Mississippi River, in light of the flood of 1993, is entering the final phase. Activities this past quarter included briefing stakeholders on methodology and data compilation efforts, and continuing with detailed analysis. Decisions have been made on methodology, and production analysis is now commencing.

The project to update the model geometry for the Mississippi Basin Model System (MBMS) for the upper Mississippi to reflect more recent mapping and to develop an inundation mapping component based on the new mapping continues in full production mode. This effort will merge the several mapping sources into a digital DTM, cut spatially located cross sections from the DTM, and integrate the new data into re-calibrated UNET unsteady flow models. Automated inundation area mapping based on UNET forecasts will be made operational for selected areas. Contracts to merge the data sources and cut the cross sections have now all been awarded. New digital cross section data started flowing to the districts this past quarter and are targeted for completion in the second quarter of FY 2000. A workshop was held that focused on tools and techniques for integration of the new digital geometry into the existing UNET models, and techniques for re-calibration of the models. The MBMS update is expected to be completed in mid- FY 2000, pending additional funding to integrate the new geometry into the model.

We completed the major reimbursable project to assist in modeling the Sacramento and San Joaquin river basins for flood control operations. Models were completed for the Sacramento Valley and San Joaquin Valley of: HEC-5 for flood control

operations; HEC-FCLP, system flood control operation optimization; and HEC-FIA, flood economic/damage impact analysis model. These models were made operational for the recent 1995 and 1997 large flood events. We initiated Phase II of the project, which consists of detailed data compilation and development of gridded HEC-HMS models for contributing watersheds to the San Joaquin and Sacramento Valleys. The gridded models will be developed in the early quarters of FY 2000.

FY 1999 wound up as a busy, productive year, with income and activities up over recent years. HEC staff continues to be strong and stable. The organizational arrangement for WRSC/HEC is unchanged, and looks to remain so for awhile yet. We are eagerly looking forward to new challenges and activities in the new millennium.

Darryl W. Davis, P.E.
Director

HYDROLOGIC ENGINEERING RESEARCH PROGRAM

Catchment Analysis System
Work Unit 32444 (research 4th/99 R99-001)

Development of Version 2.0 was completed and beta testing initiated. New capabilities include continuous soil moisture accounting with evapotranspiration, increased optimization flexibility, and increased applicability of gridded precipitation. Bug corrections have also been made that increase program performance and stability. A greatly expanded User's Manual was completed based on program changes, new capabilities, and frequently asked questions. Design of central storage and management capabilities for time pattern and paired data was initiated. The snow preprocessor is still undergoing applications testing at CRREL and should be available soon.

A draft Technical Reference Manual was completed and circulated to field offices. Comments have been received and incorporated along with additional material to reflect new capabilities in Version 2.0. A final printing is anticipated shortly after Version 2.0 is released.

The Java testing for graphics and GUI use in HEC-HMS was successful. A conversion plan has been developed whereby the graphics will be replaced universally and individual screens in the GUI will be replaced incrementally as time permits while new screens will be implemented with Java. Development of a fully functional graphics library is underway. Conversion of GUI screens will begin after Version 2.0 is released.

River Analysis System
Work Unit 32443 (training 4th/99 R99-002)

This work unit will produce a uniform set of tools for use by hydraulic engineers in a workstation environment. The River Analysis System (HEC-RAS), Version 1.0 program was completed, the Hydraulic Reference and User's manuals were published, and the package started distribution in August 1995. The program is a Windows-based standard-step model that computes steady-flow profiles for subcritical, supercritical, or mixed flow regimes. During FY 1996, Version 1.1 and 1.2 were released to provide error corrections and an added program capability. In FY 1997, in-line weirs and spillways, channel modifications, links to 3D geometric data, and numerous program enhancements were completed. The Federal Highway bridge model and scour analysis were added with FHWA funding, and Version 2.0, plus three reference documents were distributed. In FY 1998, the components of an unsteady flow program were completed for processing cross sections, bridges, and culverts. Also, steady-flow Versions 2.1 and 2.2 were developed. During the first quarter of FY 1999, HEC-RAS Version 2.2 and new program documentation were completed and distributed. Development of the unsteady-flow capability continued through the FY. A beta Version 3.0 is expected early in FY 2000.

Resolving Water Allocation and Use Conflicts
Work Unit 32976 (planning 4th/99 R99-003)

This R&D work unit features development and application of reservoir system optimization programs to assist in resolving water allocation and use conflicts that arise from changing conditions. The two primary programs are the Prescriptive Reservoir Model (HEC-PRM) and Flood Control Linear Program (HEC-FCLP). The research continues to push the state-of-the-art in operations research modeling for flood analysis by enabling more detailed representation of the system. The research is developing procedures to limit the foresight in the optimization analysis to better mimic system operation capabilities and to better model reservoir outflow and weir flow conditions. Testing of commercial “data mining” software to assist with interpretation of the output results was completed and a letter report prepared on the research and findings.

Statistical Methods in Hydrology
Work Unit 32599 (research 4th/99 R99-004)

Work Efforts concentrated on a comparison of the expected moments algorithm with the Bulletin 17B conditional probability adjustment and historic weighting procedure. Results were reviewed with former Bulletin 17B work group members.

Reservoir Analysis System
Work Unit 32602 (training 4th/99 R99-005)

The objective of this work unit is to develop a family of reservoir analysis tools to facilitate a broad range of investigations ranging from reconnaissance-level planning studies to detailed reservoir regulation plan investigations. These tools will complement the existing HEC-5

Simulation of Flood Control and Conservation Systems Program and the Prescriptive Reservoir Model, HEC-PRM. A requirements document for a new reservoir model was completed in FY 1995. During FY 1996, a basic reservoir GUI was developed to create model data and run computer programs HEC-5 and HEC-PRM. In FY 1997, the focus shifted to develop a prototype reservoir model for the Corps Water Management System (CWMS). A software design was developed to support the WCDS goals and to provide a next generation system model. During FY 1998, a prototype reservoir model was essentially completed and, during the first quarter of FY 1999, the prototype program was completed and demonstrated for the WCDS. The Test Version 1.0 was completed early in the third quarter for field testing. Additional program development and testing produced Version 1.1 and draft documentation at FY end.

Terrain-Based H&H Modeling
Work Unit 32975 (research 4th/99 R99-007B)

Hydrology. The Cooperative Research and Development Agreement (CRADA) with the Environmental Systems Research Institute, ESRI, and contracts with the University of Texas' Center for Research in Water Resources (CRWR) are working well - good progress is being made on the development of GIS terrain analysis tools, called HEC-GeoHMS, to support HEC-HMS. Technical papers have been written and the basic code developed. HEC is now working on the user documentation. The beta release was made to selected users. The work has three main components: 1) delineation of watersheds and channels to facilitate the topological description of the river basin for HEC-HMS, 2) computation of grid-based parameter for distributed modeling; and 3) estimation of HEC-HMS watershed parameters as well as general watershed/river characteristics pertinent to hydrologic modeling.

Terrain-Based H&H Modeling
Work Unit 32975 (training 4th/99 R99-007A)

Hydraulics. With the development of HEC-GeoRAS, the Hydrologic Engineering Center has linked ARC/INFO data development and display capabilities to HEC-RAS for performing hydraulic analysis. HEC-GeoRAS facilitates model development by allowing a hydraulic engineer with little GIS training to develop geometric data for import in HEC-RAS and view exported water surface profile results. HEC-GeoRAS Version 1.0 was released during the third quarter of FY 1999, including user's manual documentation. During the remainder of the FY, an ARC/View version of GeoRAS was developed, including the capability to estimate roughness coefficients for import into, and visual display of velocities exported from HEC-RAS. Development and documentation will be completed early in FY 2000.

Urban Hydrology Methods
Work Unit 32875 (research 4th/99 R99-008A)

Hydrology. Rating curves were generated to represent hydraulic structures in HEC-1 and HEC-RAS. Seven different types of hydraulic structures were tested to provide a range of conditions to compare. The rating curves were compared by examining the percent difference in the curves themselves and the peak discharge, stage, and lag-time produced from routing a variety of hydrographs through them, being sure to produce both open-channel and pressure flow conditions through the outlet. Level-pool routing was performed in HEC-HMS by importing the storage-elevation-discharge developed by HEC-1 and HEC-RAS. Guidance charts are being produced to aid in the selection of the appropriate method to represent a hydraulic structure in a hydrologic model. The charts consider slope, backwater, data quality, and required accuracy. Additionally, several options to represent hydraulic structures in HEC-HMS have been developed. The next step is to finalize the guidance charts and to choose an appropriate option for representing hydraulic structures in HEC-HMS.

Urban Hydrology Methods
Work Unit 32875 (training 4th/99 R99-008B)

Hydraulics. This work unit will develop modeling features required for many urban studies. The requirements for unsteady flow applications in the urban environment have been reviewed and defined in conjunction with the review of a UNET application for the Sacramento District. Some required hydraulic features will be incorporated with the development of unsteady flow capability in HEC-RAS. During the third quarter of FY 1999, plans were developed to use the hydraulics library, developed for HEC-RAS, to develop hydraulic ratings for water control structures. Work continued on the hydraulics library to FY end.

Flood Damage Analysis
Work Unit 32876 (planning 4th/99 R99-009)

HEC continues to develop software for more

efficient flood damage and project formulation computations. The research efforts are coordinated closely with the Risk Analysis Work Unit 32896 and Geographic Information System Work Unit 33173, Flood Damage Analysis Using GIS Technology. An updated version of the HEC-FDA program, Version 1.1, that fixes several minor computation bugs will be released during the first quarter of FY 2000. A design document was prepared and work initiated on the development of HEC-FDA Version 2.0 during the fourth quarter. Work was initiated on the conversion of the Version 1.0 Galaxy user interface to Java, a key aspect of the new version. HEC-FDA Version 2.0 will be a highly integrated flood damage analysis package that features the FDA, FIA, and the GIS flood damage analysis capabilities into a single Flood Damage Analysis Package.

Internet for Planning
Work Unit 33050 (planning 4th/99 R99-010)

This limited funded work unit targets ways to use the Internet in planning studies. The focus during FY 1999 was on its use in study management. The Tres Rios wetlands restoration study was a pilot applications where HEC provided technical assistance in water balance analysis and used the Internet as a ways of conveying study information and results to others. The work unit was completed during the second quarter of FY 1999 with the intent on the use of the Internet becoming a normal process within the framework of the study.

Analysis of Ground-Surface Water Interaction
Work Unit 32703 (research 4th/99 R99-022)

Work continued through coordination with our co-developer of HMS-MODFLOW in the USGS . Funds have been secured for model development and application of the model to the Humboldt River Basin, Nevada.

Development of an Initial Data Warehouse for Coralville Reservoir Water Balance Analysis
Work Unit 33104 (research 4th/99 R99-023)

Work continued at the University of Iowa; the basic data set has been enlarged and updated on the university computer. A final report for the data warehouse at the Corps Coralville is being prepared for the Comprehensive Flood Impact Response Modeling System (CFIRMS) by the University. This work concludes at the end of FY 1999.

RISK ASSESSMENT RESEARCH PROGRAM

Risk-based Analysis for Flood Damage Reduction Studies Computer Program
Work Unit 32896 (planning 4th/99 R99-030A)

The HEC-FDA risk-based analysis enhancements for the Version 2.0 program continues at a brisk pace. During the quarter, the work concentrated on adding project costs with uncertainty and adding net benefits and B/C ratio distributions to the output reports. The work is coordinated closely with the Flood Damage Analysis Work Unit 32876. HEC-FDA operates in Windows 95, 98 and NT, and Sun Solaris UNIX-based operating systems. The package includes a modern GUI, enhanced project damage and performance calculations, and graphical outputs. Uncertainty algorithms for exceedance probability, stage, and damage are an integral part of the program. The program output is consistent with present Corps guidance of ER 1105-2-101, Risk-based Analysis for Evaluation of Hydrology/Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies and EM 1110-2-1619, Risk-based Analysis for Flood Damage Reduction Studies.

Hydrologic Risk & Uncertainty & Environmental Restoration Performance
Work Unit 33214 (planning 4th/99 R99-031)

This work unit develops, documents, and deploys procedures for hydrologic engineering analysis associated with riverine environmental restoration studies. The analysis of low- and high-flow regimes affecting the design, maintenance, and operation of the project over its life is quantified along with associated uncertainty considerations of the project. Emphasis is on defining and developing methods for hydrologic variables, and defining key uncertainty components that are important to riverine restoration investigations. The HEC work is part of associated efforts of the Environmental Lab (CEERD-EV) and the Institute for Water Resources (CEWRC-IWR) who are responsible for the biological and policy aspects of the R & D work, respectively. HEC's fourth quarter activities concentrated on developing a draft of a Hydrologic/Hydraulics Guide Manual for Riverine Restoration Studies. A workshop with participants from the three research offices and district offices involved in riverine restoration studies was held at HEC during the quarter. The workshop enabled the districts to present their approaches to riverine environmental restoration projects and to help focus the R&D efforts by HEC, CEWRC-IWR and CEERD-EV.

Incorporating Cost Uncertainty into HEC-FDA
Work Unit 33158 (planning 4th/99 R99-032)

HEC is working with the Institute for Water Resources (CEWRC-IWR) on implementing cost and associated uncertainty analysis into the HEC-Flood Damage Analysis (HEC-FDA) Version 2.0 program. The project cost analysis, along with the existing program's flood damage reduction analyses with uncertainty, will enable net benefit analysis with uncertainty to be computed in the program. The design for implementation was completed during the quarter and coding to install the routines into HEC-FDA Version 2.0 initiated. CEWRC-IWR is funding the work from a separate work unit of the Risk R&D program.

GEOGRAPHIC INFORMATION SYSTEM RESEARCH PROGRAM

Flood Damage Analysis Using GIS Technology
Work Unit 33173 (planning 4th/99 R99-040)

Development of software to conduct flood damage analyses in a more integrated manner, reduce field survey time and effort, and generate easier to interpret output and displays are objectives of this work unit. The use of spatially referenced data for analysis and displays are the basis of the R&D effort. The approaches will be merged into the HEC-FDA Version 2.0 package. The software is also coordinated with flood impact analysis software being developed under CWMS activities. The work continues for alternative GIS methods for structure inventories, damage, and displays including: 1) aggregations and computations by grid cell, census, and parcels data coverages; 2) computations using aerial photograph images, digital elevations, and flood inundations; and 3) spatial output displays for a range of hypothetical, observed, or forecasted spatially distributed flood inundations generated by HEC-GeoRAS. A prototype of the structure inventory tied to the HEC-FDA database and damage calculations for a event flood inundation depths were completed during the quarter.

Integration of Models and Spatial Technologies
Work unit 33175 (research 4th/99 R99-041)

A meeting was held at USACERL to review descriptions of models, previously input to the catalog of Corps capabilities. Also, the basic structure of the model's catalog was reviewed and revised. HEC's main responsibility in this multi-Lab work unit is to provide a case study of connecting engineering software to commercial, off-the-shelf GIS systems. The HEC-GeoRAS ARCINFO pre- and post-processor for HEC-RAS was released and taught in a Corps workshop. The ArcView version of GeoRAS is being finalized. HEC continues its work with the University of Texas and the Environmental Systems Research Institute to enhance GIS applications for HEC's HMS and RAS models. A beta version of GeoHMS underwent extensive testing. The question of how to best store gridded data in HEC-DSS and access it from the applications models is being addressed by HEC with assistance from leaders in the profession.

RISK ANALYSIS FOR DAM SAFETY RESEARCH PROGRAM

Assessing Hydrologic Loading Uncertainty
Work Unit 33257 (research 4th/99 R99-051)

A memorandum was developed describing technical problems and analysis methods for estimating hydrologic loadings (i.e., rare large floods).

Estimating Probability of Extreme Floods
Work Unit 33258 (research 4th/99 R99-052)

A University of Maryland report describing approaches to estimating dam failure risks for HQUSACE was reviewed. A contract was initiated to develop stochastic precipitation model for case study of Folsom Dam on the American River.

CORPS WATER MANAGEMENT SYSTEM

The significant tasks for FY 1999 were to install the CWMS Test 1.0 system software in selected field offices, and continue development toward the final version two years hence. Activity this past quarter focused on re-installation of Version 1.0. This was the first of two planned interim test installations prior to Test 3.0/CWMS Version 1.0, which will complete the system that will be deployed Corps-wide in 2001/2002. Activities that continued throughout the fourth quarter focused on resolving problems that arose during installation at the four sites of Baltimore, Huntington, Omaha, and North West Region - Portland. Material about this project is posted on the Web at: http://cw71.cw-wc.usace.army.mil/cwcinfo/cwc.html. A meeting of the senior management level Advisory Group was held in July. Focus is now turning to new developments for Test Versions 2.0 and 3.0. (executive 4th/99)

Data Capture
(tech asst 4th/99 AEM W99-050)

Work continued on finalizing installation of Version 2.0 of the data capture software. The data capture software allows a GOES or AFOS data stream to be fed into the Water Control Data System where it is decoded and posted to the Oracle database.

Data Decoding, Transformation and Validation
(tech asst 4th/99 AEM W99-051)

In the fourth quarter, the inclusion of real-time mathematical and table lookup transformation of data as it is received and posted to the Oracle database was implemented in Version 1.0. This "on-the-fly" processing of data can reduce the extra resources of some of the processing that would normally take place after the data has been initially stored in the database. Work continued in the final design and development of the processing of time series data in blocks and Version 2.0 components.

Data Base System
(tech asst 4th/99 DJB W99-052)

Data base system testing experience and field test site feedback indicated a need for the data base component to be improved to perform at a peak rate of 3500 values per minute for storage of data delivered through the data acquisition component. The fielded technology using a Java data base interface server, Java data base connectivity protocol, and Oracle stored procedures has apparently reached its performance limits at about 200 to 2000 values per minute, dependent on amount of data resident in storage tables. Recommended improvements to achieve the requirement of 3500 values per minute, include modification of the Java data base interface, the implementation of an Oracle Pro*C application to perform data base I/O and business rules checking, and the use of JNI protocol to integrate these elements. The proposed technology eliminates the need to do business rules checking in stored procedures which is a significant time cost in the current technology. Also eliminated, is the need to always use network protocol (JDBC) for data I/O. Because of funding issues, implementation of this proposal was moved to FY 2000. Therefore, the improved performance capability target was moved into Version 2.0 for completion by 28 February 2000.

Version 1.0 of the data base system component was complete for development and testing by 30 September 1999. Installation at the four field test sites was scheduled for October 1999. Although it was necessary to delay meeting performance goals, the stability and performance of the system greatly improved from the earlier field implementations. Development of the field test 2.0 data base system component is scheduled to begin in November 1999.

Data Dissemination
(tech asst 4th/99 CWF W99-053)

Data Dissemination work for the fourth Quarter of FY1999 continued to be focused on the installation activities associated with fielding of the Corps Water Management System (CWMS) software at four Corps locations. At each of the installation locations, an Apache Web server was installed along with an example set of Web pages. A sample set of Web pages provides practical examples of how to access and display data from the Oracle database. They include display of data as plots, tables, gif images and PDF files. Each of the field test sites are implementing local interfaces to their existing Web servers. There is continuing concern regarding the impending implementation of firewalls at the CEAP Internet interface and at each local district/division office. The details regarding the generation and posting of data related products remains uncertain.

Data Archiving
(tech asst 4th/99 DJB W99-054)

Archiving is required to provide data for mission performance accountability, to enable Corps offices to disseminate and/or exchange data, and to provide a consistent data file system suitable as legal documentation. Automated means will be provided for periodic archiving and as needed purging of information from the CWMS data base. Means will also be provided for automated retrieval from the data archive and placement into the CWMS data base or standard dissemination files. Data archiving was included in the requirements and software design process being overseen by the Data Base SDT Team. Data archiving, was not included in the field Test 1.0 software suite. Significant work on this issue is planned for field Test Version 2.0.

Flow Forecasting and Forecast Evaluation
(research 4th/99 W99-055)

The MFP program was modified to read gridded precipitation directly from the database file where it is stored, rather than from a local file that must be created independently for each forecast. The gageInterp program was embedded in a script that also extracts gage precipitation from the database, completely automating the production of precipitation grids, so that it can be executed by cron. Needs for improved computation status information and data visualization were identified for work in Version 2.0. Flow and stage forecasting via HEC-HMS and HEC-RAS are functioning as intended in the test version.

Reservoir System Simulation
(training 4th/99 W99-056)

Starting in FY 1997, requirements for real-time reservoir simulation were completed, a planning budget was developed, and priorities were set to fit the initial budget. Then a conceptual design document was developed to define program operation and a prototype plan was developed for initial program development. During FY 1998, the prototype reservoir program and pilot project data were completed. During the second quarter of FY 1999, Version 1.0 installation started with the Baltimore and Huntington Districts, and installation in the remaining two offices was completed during the third quarter. Model testing continues with those offices. Version 1.1 modifications were completed during the fourth quarter and program field testing will begin early in FY 2000.

River Hydraulics and Stage Forecasting
(training 4th/99 W99-057)

This element started in FY 1997. During the first half year, program requirements for river-stage forecasting were developed, reviewed, and completed; and a planning budget was developed. During the second half, a conceptual design document was developed and plans for a prototype program were completed. In FY 1998 a real-time interface for HEC-RAS for the CWMS was completed and integrated into the software system. During FY 1999 the interface update was completed to meet Version 2.2 capability. The updated software was included in the CWMS installation to Baltimore, Huntington, and Omaha Districts, plus the North West Region - Portland. Development of the unsteady-flow modeling for the CWMS was initiated in the fourth quarter.

Flow Impact Analysis
(planning 4th/99 W99-058)

The Flow Impact Analysis (HEC-FIA) computer program development continues with debugging and testing performed during the quarter. Modifications for UNIX operations and integration with the Control and Visualization Interface (CAVI) for the CWMS were completed. The procedures for incorporating the project benefit accomplishments component of the program with links to the HEC-RSS hold-out analysis output were incorporated into the program. HEC is also working with the RS/GIS Center at CECRL on their implementation of the GIS flood impact analysis capabilities for water control applications. The program is being designed and tested under the general direction of the water control flood impact analysis design team consisting of Corps field offices, CECRL, and HEC representatives. The beta version is being applied for test installation sites. The goal is to have the HEC-FIA Version 1.0 program ready for release and fully integrated with the CWMS system by the second quarter of FY 2000.

System Integration, Implementation, and Management
(tech asst 4th/99 AFP W99-059)

The activities of the fourth quarter of FY 1999 were continued to be impacted by the test installation of the CWMS software at the four test field sites. Quarterly progress charts have been updated to reflect progress of the development and installation of Version 1.0 of the new CWMS software.

Weekly pre-installation conference calls to coordinate activities at the various installation sites and the CWMS developers were continued. The phone conferences are typically held on Wednesday mornings each week and focus on reports from each of the developer team members and each of the installation sites. This forum has been particularly useful in allowing discussions about different aspects of the CWMS software and to disseminate information about up-coming installation activities. These calls continue throughout the installation activity.

The set of scripts that control the starting of each CWMS component have been revised. The newly developed procedures log the critical steps to provide better tracking of their execution. Checks are included to prevent continuation when files or other processes are not running. Scripts were also refined to be more general across sites. Scripts now use consistent system environment variables to define system specific information.

Refinements to the CWMS software structure have also continued. In addition to alterations to the CWMS directory structure, properties files containing CWMS system variables have been implemented. The property files are used by each of the software components to establish items like network addresses, port numbers, number of process threads, etc. When fully implemented the property files will exist in the same directory and specify all of the CWMS system parameters.

A management utility was developed to locate and perform cleanup activities in the file system. FileHunter will identify files that conform to a specified file mask. Conforming files may then be deleted, moved to a holding area, or have another process act on them. This utility will be run periodically to keep the file system managed.

Application of GIS and Image Technology
(research 4th/99 W99-060)

GIS programs for snowmelt forecasting have been integrated with the HEC-HMS modeling environment. This snowmelt forecasting system mirrors the gridded Mod-Clark procedures for rainfall runoff forecasting. The system consists of algorithms for preparing gridded input data, i.e., temperature and snow water equivalent, a distributed snow process model (DSPM), and export visualization routines for CorpsView. Version 2.0 implementation plans for flood impact analysis using GIS have been formalized. CorpsView implementation at NWD has been delayed and will be completed in the first quarter of FY 2000.

Control and Visualization Interface
(tech asst 4th/99 WJC W99-061)

A new methodology for plotting data from the icons has been incorporated. In earlier versions, the CAVI would look for all HEC-DSS pathnames that had the C and F parts in the plot parameters and alternative lists on the right side of the window. If one or more of the parameters was not available for that location, it would still search for that data set. (For example, if Elevation or Storage was in the list, and a plot was requested from a subbasin icon, the CAVI would look for that data for the subbasin.) As a result, many data sets were being looked for during a plot, even though only one or two were really there. Now the pathnames of the data sets to plot (and tabulate) are explicitly specified. This solves the problem where different location names were being used at a reservoir, and more than one icon was needed for plotting. Pathnames may be entered through the properties editor by directly typing them into the “Data Name” or Pathname” column in the table at the bottom of the editor, or by pressing the “Browse DSS” button. This opens a pathname selection browser to add or replace, pathnames in the properties editor list. Use of this browser is relatively self explanatory.

Field Application Assistance
(tech asst 4th/99 CWF W99-062)

During the fourth quarter of FY 1999, support for the installation of CWMS continued. The support needed to implement this suite of software has been considerably greater than first anticipated. Lessons learned from this experience will be very helpful for understanding how features of the system can be simplified in the next Field Test version.

Support dealing with Data Acquisition included extensions of processing the data streams received. Considerable effort has been given to the loading of data through the Data Base Interface (DBI) into the Oracle Database. Also considerable time was spent on reducing inefficiencies of the data capture and loading process. Most of the effort was spent in finding errors which were generated during the modeling process. The use of weekly telephone conference calls has proved helpful to coordinate activities between the HEC and the four field sites.

NUMERICAL MODEL MAINTENANCE AND SUPPORT

Numerical Model Maintenance for the family of HEC software consists of bug fixes and minor updates, hardware/software platform support, documentation updates and hot-line technical support. Corps offices that subscribe for these fee services receive full support including: new software releases; interim updates and bug fixes; user's manuals and supporting documentation; short-duration technical consulting; and hot-line technical assistance via E-mail, fax, and telephone. Corps offices that do not subscribe are limited to the same courtesy afforded to other federal agencies: referral to HEC Web page and the National Technical Information Service (NTIS) for major software release versions; HEC Web page and NTIS for documents; and response to official correspondence regarding potential program errors and bugs. Subscription fees for FY 1999 total just over $500,000. The primary software within each numerical model area together with the number of requests for assistance over the previous one year period, are shown below. A discussion of significant activities in each of the modeling areas follows the table. Mailings for FY 2000 subscriptions took place in August. The fee structure was slightly revised and simplified, and the IFH category consolidated with "Hydrologic Analysis." A stream lined billing and notification system was implemented to improve funds receipts over that which occurred in FY 1999. (executive 4th/99)

Numerical Model Area	Primary Software	Latest four quarters Calls for assistance				
		1st Quarter FY 98	2nd Quarter FY 99	3rd Quarter FY 99	4th Quarter FY99	Totals
Hydrologic Analysis	HEC-1, HMR52, HEC-HMS	74	61	55	45	235
River Analysis Systems	HEC-RAS, HEC-2, UNET, HEC-6	33	38	43	40	154
Flood Damage Analysis	FDA	41	47	33	38	159
Hydrologic Statistics	HEC-FFA, STATS	2	17	6	10	35
Reservoir System Analysis	HEC-5, HEC-5Q, HEC-PRM	10	4	10	21	45
Data Storage System	HEC-DSS	4	23	45	35	107
Interior Flood Hydrology	HEC-IFH	7	5	3	5	20
TOTALS		171	195	195	194	755

Hydrologic Analysis ***(HEC-1, HMR52, HEC-HMS)***
(research 4th/99 M99-001)

Maintenance this quarter continued to concentrate on user support for HEC-HMS Version 1.1 both in application assistance and bug correction. Development of Version 2.0 was completed and final testing initiated. An expanded user's manual was completed. A draft technical reference manual was completed and circulated to field offices for comment. Other support was provided for HEC-1, HMR52, urban H&H models; and the groundwater model MODFLOW.

Flood Frequency Analysis ***(HEC-FFA, STATS)***
(research 4th/99 M99-004)

Program support was provided for program FFA and STATS.

Interior Flood Hydrology ***(HEC-IFH)***
(research 4th/99 M99-007)

Several instances of computer program application support was provided to field offices during this period.

***Flood Damage Analysis** (HEC-FDA)*
(planning 4th/99 M99-003)

Consultations with Corps offices using risk-based analysis methods remain at a high rate. Enhancements and corrections to the HEC-FDA program and its database processing procedures were made during the quarter. Work on fixing minor bugs in the program for the Version 1.1 program release continued during the quarter.

***River Analysis Systems** (HEC-RAS, HEC-2, UNET, HEC-6)* (training 4th/99 M99-002)

Application assistance and one-stop phone assistance continues for HEC-2, HEC-6, UNET, and HEC-RAS. Version 2.2 of HEC-RAS was distributed with new program documentation. A Version 2.2.1 patch was released during the third quarter to correct two compute problems. HEC-RAS and UNET have continued to be the focus of model assistance. During the fourth quarter, a contract was issued to assist in developing an updated version of UNET.

***Reservoir System Analysis** (HEC-5, HEC, 5Q-HEC-PRM)* (training 4th/99 M99-005)

General maintenance and field support activities for the HEC-5 family of programs continue. Program updates and modifications for complex system operation goals continued. Program assistance continues on a request basis. An HEC-5 Version 8.1 is being prepared for release in FY 2000.

***Data Storage System** (HEC-DSS)*
(tech asst 4th/99 AEM M99-006)

Support activities for the fourth quarter were primarily centered around providing telephone support and routine maintenance for the various data management tools. Most of the support centered around the primary HEC-DSS management tools, such as SHFDSS, DSSSHF, DWINDO, DSSUTL, DSPLAY , REPGEN, and DSSMATH. The 'Y2K' compliant SHEFDSS was made available for Corps wide distribution this fourth quarter. Some extensions to DSSMATH were made that allow periods of accumulated precipitation that are reported in NCDC (National Climatic Data Center) data sets to be converted to missing, or be uniformly distributed over the accumulation period.

Technical Assistance and Special Projects

Technical Assistance Projects are reimbursable projects performed for HQUSACE, Corps district and division offices, research laboratories, other federal agencies, and local governments. The scope of each project is negotiated on a case-by-case basis, including the full range from technical advisory services, review and oversight of studies by others, to performance of all aspects of investigations. Arrangements are made such that contracting associated with technical assistance projects is credited to the sponsoring office's contracting-out percentage. New projects begun this quarter include: initiation of Phase II of the Comprehensive Sacramento/San Joaquin basins investigation (SPK); assistance for dredged material disposal (SPN); developing HEC-HMS models for the Cumberland basin (ORN); assistance with Anacostia River Watershed Study (NAB); and several project material reviews (SPK, CRL, MVR, NWD, and SWD). (executive 4th/99)

HQUSACE

CECW-EH

Mississippi Basin Model System Model Update

(executive 4th/99 P99-004) **$960,000**

HEC is managing the project that is updating the model geometry for the Mississippi Basin Model System (MBMS) for the upper Mississippi to reflect more recent mapping and to develop an inundation mapping component based on the new mapping. The project continues in full production. The project is merging several mapping sources into a digital terrain model (DTM), cut spatially located cross sections from the DTM, and integrate the new data into re-calibrated UNET models. Automated inundation area mapping based on UNET forecasts will be made operational for selected areas. Contracts to merge the data sources and cut the cross sections have been awarded. Location of cross sections, electronic bathymetry, and integration of the new geometry into the existing models is being accomplished by the St. Louis, Rock Island, St. Paul, Kansas City and Omaha Districts. Mapping contracts for DTM development and geometry extraction are being managed by the St. Louis District. New digital cross section data will start flowing to the districts in the fourth quarter and be completed in the second quarter of FY 2000. A workshop was held that focused on tools and techniques for integration of the new digital geometry into the existing UNET models, and techniques for re-calibration of the models. The quarter ended with tasks remaining for FY 2000. Additional funds have been requested.

Residual Flood Risk

(planning 4th/99 P98-021) **$ 50,000**

HEC is developing procedures and capabilities to better define and communicate the residual flood risk associated with existing or proposed project conditions. This includes addressing residual risk for various flood conditions, project types (levees, channels, detention storage, nonstructural measures) and physical settings (population at risk, egress, damage potential) consistent with requirements of ER 1105-2-100, ER 1105-2-101, and EM 1110-2-1619. Within this framework, the analytical procedures and capabilities to better depict and communicate residual risk for formulating and evaluating flood damage reduction plans are being derived and incorporated into the HEC-FDA Version 2.0 Package. Included are methods using risk and uncertainty to develop project performance and site information. Where applicable, the methods will be incorporated into the HEC-FDA Version 2.0 package and distributed to Corps offices via such means as brochures, videos, and CD's.

Hydrology Committee

(research/4th 99 P99-009) **$22,500**

The next meeting of the Corps Hydrology Committee will be 07-08 December 1999 at HEC. HEC is coordinating the meeting which will include topics on the Sacramento District comprehensive study and frequency analysis.

GAGE Computer Upgrade

(tech asst 4th/99 P98-093) **$19,883**

The gage Oracle/Web application software was successfully used in the previous Corps-wide data

update cycle. Work is now deferred pending compilation of comments and improvement needs resulting from field experience. Conversion of the gage application to use the CWMS field test 1.0 data base was completed in the fourth quarter. Improvements and corrections to the gage applet are scheduled in the first two quarters of FY 2000. A new set of reports will be added to gage applet system in FY 2000.

CECW-PF

FPMS Support

(training 4th/99 P99-005) **$30,000**

HEC prepared a technical paper on the application of new GIS procedures to develop input to HEC-RAS and to display output as floodplain mapping. The paper was presented at the annual Association of State Floodplain Managers Conference in Portland, Oregon, at the end of May. Field assistance continued as requested.

Engineer Research & Development Centers

Construction Engineering Research Laboratory

LMS to WCDS

(research 4th/99 P99-017) **$40,000**

A preliminary report on recommendations for LMS based on experience with WCDS was provided to WES. Additional review of the applicability of the Crops life cycle management information system, LCMIS, to the Land Management System, LMS was also made.

Coastal Hydraulic Lab

LMS Development Team

(research 4th/99 P99-012) **$20,000**

HEC is participating in the management oversight team for development of the Corps new Land Management System, LMS. Several documents have been reviewed and meetings attended.

Mississippi Valley Division

Rock Island District

Upper Mississippi River System Flood Frequency

(research 4th/99 P99-003) **$100,000**

Completed final draft of flood distribution selection report. Report provided to study chairman for review.

Reservoir Modeling

(training 4th/99 P99-019) **$50,000**

Rock Island District has requested development of rule-based reservoir simulation as a component of the water control data system (WCDS). During the third quarter, HEC conducted a test and developed a progress report on the concept of using multiple-linear programming to "solve" the release decision based on reservoir-release rules. During the fourth quarter, HEC developed a reservoir operations plan to meet District requirements along with WCDS requirements.

HEC-FIA Modeling

(planning 4th/99 P99-018) **$30,000**

HEC is assisting the Rock Island District with development of a HEC-FIA model for the Iowa and Des Moines River basins and extending it downstream on the Mississippi River to Quincy, Illinois. A working model for the system was completed and undergoing final testing at the conclusion of the quarter.

St. Paul

Devils Lake
(research 4th/99 P99-032) **$3,500**

Developed memorandum summarizing implications of current climate change research for standard flood frequency analysis. Attended meeting in Bismarck to discuss lake level frequency forecasts.

Northwestern Division

HEC-5 on the Cumberland
(training 4th/99 P99-014/015) **$24,000**

HEC processed flow data and developed initial HEC-5 data models. Detailed hydropower data was expected; however, only some unit testing was possible. HEC completed models for the updated data. This project is complete.

South Atlantic Division

Charleston District

HEC-5 Model
(training 4th/99 P99-007) $14,000

HEC is providing assistance to the Charleston District developing an HEC-5 reservoir model for the Pee Dee River. During the first quarter, data assembly began and a framework HEC-5 data set was developed. During the second quarter, the HEC-5 model was completed. A tech-transfer meeting was held in April. This project is completed.

Mobile District

Panama Canal Base Model
(training 4th/99 P98-073) **$149,420**

HEC is assisting the Panama Canal Commission (PCC) with an analysis of surface water availability for canal expansion. During FY 1998, HEC developed flow data for modeling and developed an HEC-5 and preliminary HEC-PRM reservoir system models for the existing system. During the first quarter of FY 1999, HEC presented an HEC-DSS workshop on the DSS programs used for data processing and an HEC-5 modeling workshop to the PCC staff. Reservoir model development for existing conditions was completed during the second quarter and an HEC-PRM workshop was presented to PCC staff during March. The draft flow-data report was completed and sent during the third quarter. The report was reviewed and final copies were sent during the fourth quarter. This project is complete.

Choctawhatchee-Pea River
(research 3rd/99 P98-082) **$10,000**

The flood forecasting system was completed and the project concluded.

South Pacific Division

Los Angeles District

Santa Ana River
(training 4th/99 P99-008) **$65,750**

HEC is developing an HEC-RAS model of the upper Santa Ana River. This will be a demonstration project using GIS data, and the new procedures, developed under the GIS work unit, to develop model data and to present model results. A tech-transfer workshop is planned to present the procedures used and the study report will likely be published as an HEC Project Report. The project just started during the first quarter of FY 1999 and basic data are still being assembled. During the second quarter, a field review of the project was conducted and study plans were developed. During the third quarter, HEC-RAS modeling was nearly complete and sediment modeling was initiated. During the fourth quarter, modeling and

mapping were completed. A final draft report was provided to the district along with models and results. This project is complete and the final report will be sent in October.

LAPRE-1 Capabilities for HEC-HMS

(research 4th/99 P98-094) **$19,000**

Maintenance this quarter continued to concentrate on user support for HEC-HMS Version 1.1 both in application assistance and bug correction. Development of Version 2.0 was completed and final testing initiated. An expanded user's manual was completed. A draft technical reference manual was completed and circulated to field offices for comment. Other support was provided for HEC-1, HMR52, urban H&H models; and the groundwater model MODFLOW.

Tres Rios GIS Database

(planning 4th/99 P99-020) **$30,000**

HEC is providing technical assistance to the Los Angeles District's Phoenix office on its Tres Rios constructed wetlands feasibility study. HEC's help is primarily for analysis of alternative wetland configurations and plans on the flood damage to near-by residential and commercial structures. Analyses and spatial displays generated by GeoRAS of flood inundations, velocities, and depths for various events and plans were developed and presented to the key stakeholders during the quarter.

Sacramento District

Phase I Sacramento and San Joaquin River Basins Comprehensive Study

(planning4th/99 P98-049) **$385,000**

HEC has agreed to continue assisting the Sacramento District with its Sacramento and San Joaquin River Basins Comprehensive Study. HEC's Phase I effort was completed during the second quarter of this FY. It developed basic level flood damage and reservoir system models for the Sacramento and San Joaquin watersheds. Now in Phase II, HEC will further refine those models and additionally develop comprehensive HEC-HMS models for both watersheds. An extensive data assembly effort was initiated during the quarter for the 1995 and 1997 flood events. This includes gathering flow, stage, rainfall, temperature, and snow records from over 50 different agencies. These data are to be reviewed and cleaned-up for subsequent modeling use.

Reservoir System Modeling. Two types of reservoir system analyses are performed: simulation modeling using the HEC-5; and optimization analysis of water allocation of the systems using the HEC Flood Control Linear Program (HEC-FCLP). The Phase II effort will further refine the Phase I models for the Sacramento and San Joaquin systems for the 1995 and 1997 floods. The models will utilize the HEC-HMS generated hydrographs for inflows to the reservoirs and local contributing flows for the two events. The HEC-5 analysis will derive a reservoir system simulation set of models for the watershed. The Phase I HEC-FCLP models will be converted from the batch program into the new HEC Reservoir System Simulation -Linear Program (HEC-RSS-LP) Windows GUI. It will be subsequently used to assess the operation rules and system effects of the individual watersheds.

Flood Impact Analysis. HEC-Flood Impact Analysis (HEC-FIA) models for the Phase I level Sacramento and San Joaquin basins were completed during the third quarter. The Phase II models will be further calibrated to the 1995 and 1997 observed event data. Information for the 87 impact area will be significantly upgraded. This includes the stage-urban damage, stage-number of structures, and stage-population functions, as well as, crop distribution patterns. The HEC-FIA models will enable planning and real-time event assessments of flood impact of the Sacramento and San Joaquin systems.

Tooele Army Depot Groundwater

(research 4th/99 P99-006/016) **$50,000**

Final Project Report (PR-42) completed and presented to Sacramento District. New seismic data on depth of bedrock block was reviewed. Meetings were held with the District and Utah EPA regarding upcoming calibration study due January 2000.

Friant Dam

(research 4th/99 P99-029) **$3,000**

Independent technical review of regulated frequency curve study was completed.

Other Agencies

Metropolitan Water District of Southern California

Upgrade of HEC-DSS

(tech asst 4th/99 WJC P97-105) **$48,000**

A design document on an upgrade to the two-dimensional graphics portion of the program was written and distributed for comments. The document was subdivided into three priority categories. Work on implementing the first priority category was started near the end of the quarter. Prior quarter remarks follow.

The Metropolitan Water District of Southern California, the California Department of Water Resources, and HEC are combining resources to develop a new Graphical User Interface (GUI) for the HEC-DSS package. This tool will provide greater graphing and data manipulation capability of data in a HEC-DSS data base. The tool is being developed in the Java programming language, and will run under most operating systems including UNIX, Windows 95 and Windows NT.

A "map-based" interface has been developed which can act in a client-server mode, if desired. The map GUI is being developed in conjunction with the Water Control Modernization "CAVI" Project (so we have additional resources to work on the same software). The GUI reads in a map configuration file that can be produced from several sources, such as a GIS. The map has several tool items, like zoom, pan, etc. A user will select the data parameter and version from a box on the right side of the map, then select a location to either plot, tabulate, etc., the data.

This project is closely coordinated with the CWMS modernization project. Work will be re-initiated subsequent to completion of installation of Version 1.0 and associated validation efforts.

National Institute of Building Sciences

Potential Flood Loss for HAZUS

(executive 3rd/99 P98-071) **$30,080**

The Federal Emergency Management Agency (FEMA) is sponsoring the development of a flood loss module addition to the HAZUS model. HAZUS is a multi-hazard modeling and analysis software system currently operational for earthquakes. Additions now underway include wind and flood hazards. FEMA has engaged the National Institute of Building Sciences (NIBS) to manage the project. In turn, NIBS has contracted for model development with private firms. Model development is guided by multi-agency, university, private sector oversight committees formed for each hazard component. The HEC Director is contracted to serve as a committee member for the flood module. Activities to date this FY include participation in committee meetings that addressed: phase I model development proposals and proof-of-concept applications; contract proposals for phase II work; and evaluation of proposed default national data base attributes. A new contract will be initiated beginning in FY 2000 that will continue advisory services model development progress.

TECHNOLOGY TRANSFER

Two PROSPECT courses were presented during the fourth quarter, as shown in Table 1. The Water and the Watershed Course provides participants with an understanding of the physical nature of the water of the watershed (that area of land that drains to a common outlet along a stream), and the conceptual, technical and institutional tools available for planning and management. The course covers the occurrence, movement, storage, and control of water (surface and ground water hydrology); the processes and history of the natural development of the landscape (geomorphology); the concept of the watershed as a bioregion and the interrelationships of natural systems (watershed ecology); the role of the soil mantle as a living filter and the effects of wastewater on stream and river water quality; the development of the water for water supply and irrigation, hydroelectric power, recreation; the protection of persons and property from flooding; the preservation, conservation and restoration of natural features such as wetlands; and the social, cultural and institutional elements of water management.

The Groundwater Hydrology class provides concept procedures, and techniques employed in the analysis, investigation, and management of groundwater resources. Course instruction is provided on: basic principles of groundwater hydrology; theory of groundwater flow; aquifer characterization; analysis of seepage and drainage problems; and modeling of groundwater aquifers. Case studies illustrate basic principles, and a field review demonstrates data collection and pump tests.

Other Training Activities

One HEC-RAS workshop was presented during the fourth quarter, as shown in Table 2. HEC provided an HEC-RAS workshop to State and local engineers in North Carolina, sponsored by the Charleston District and State Floodplain Management.

Table 1. HEC FY 1999 PROSPECT TRAINING SCHEDULE

Course Title	Date	Length (weeks)	Number Students
Basic HEC-RAS	26 - 30 Oct 1998	1	24
Risk-based Analysis	16 - 20 Nov 1998	1	15
GIS - Hydrologic Engr	12 - 16 Apr 1999	1	30
Flood Hydrology with HEC-HMS	17 - 21 May 1999	1	31
Water and Watershed	12 - 16 Jul 1999	1	33
Groundwater Hydrology	16 - 20 Aug 1999	1	20
	TOTALS:	6	153

Table 2. HEC FY 1999 WORKSHOPS

Title	Sponsor	Date	Length (days)	No. of Students
HEC-DSS Workshop	Panama Canal	17 - 20 Nov 1998	4.0	7
HEC-HMS Workshop	FEMA	30 Nov - 4 Dec 1998	4.5	30
HEC-5 Workshop	Panama Canal	1 - 4 Dec 1998	4.0	8
HEC-HMS Workshop	CENWO	12 - 15 Jan 1999	3.5	24
Flood Damage Analysis	CECW-PM	9 - 11 Mar 1999	3.0	15
HEC-PRM Workshop	Panama Canal	17 - 19 Mar 1999	3.0	5
HEC-RAS (E.Lansing, MI)	CELRE	11 - 14 May 1999	3.5	27
HEC-HMS (Indianapolis, IA)	CELRE	22 - 25 Jun 1999	3.5	28
HEC-RAS (Raleigh, NC)	CESAC	24 - 27 Aug 1999	3.5	15
		TOTALS:	32.5	159